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# ORGANIZATIONAL INNOVATION, R&D AND PRODUCT INNOVATION: FIRM-LEVEL EVIDENCE FROM ASEAN COUNTRIES

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**Abstract**
The study explores the direct effects of organizational innovation and R&D (research and development) and the complementary effect of these two factors on the likelihood of innovation at a higher degree of radicalness in ASEAN. This research focus is important as little is known about the role of organizational innovation and the combination of this type of innovation with R&D for product innovation efforts. The study uses cross-sectional data from the World Bank's Enterprise Survey in 2015-2016 and a generalized ordered logit model to address the common limitation of the standard ordered logit model in estimation. The findings show that both organizational innovation and R&D have significantly positive effects on the possibility of innovation at a higher degree of radicalness. The positive complementary effect of organizational innovation and R&D is also supported. The practical implications emphasize that ASEAN firms should devote more resources to organizational innovation and R&D to boost their product innovation performance.

**Research paper**

**Keywords:** ASEAN; Generalized ordered logit model; Organizational innovation; Product innovation; R&D

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## Introduction

Innovation is the primary determinant of a firm's competitiveness (Tavassoli & Karlsson, 2016). In order to enhance innovation at the firm level, investment in R&D is considered an important internal resource that forms a "basic competence" for technological innovation (Tidd, 2000). Furthermore, organizational innovation can improve intra-organizational coordination and create an appropriate environment to facilitate creativity and flexibility, ultimately leading to better technological innovation (Azar & Ciabuschi, 2017; Damanpour, Szabat, & Evan, 1989; Haned, Mothe, & Nguyen-Thi, 2014). Given the crucial roles of R&D and organizational innovation in product innovation, there have been many studies on this topic in developed economies (Anzola-Román, Bayona-Sáez, & García-Marco, 2018; Cozzarin, 2017; Haned et al., 2014). However, the evidence in developing economies is still limited, especially research on the role of organizational innovation.

ASEAN (Association of Southeast Asian Nations), except Singapore–a highly developed economy, is a developing region with a robust growth rate of more than 5% in 2018 (OECD, 2019). The region is shifting to a more knowledge-intensive and innovative economy, rather than low-wage and labor-intensive production (ERIA, 2018). Thus, it is interesting to explore the role of organizational innovation and R&D in product innovation in ASEAN–a fast-growing and dynamic economic region. Specifically, the objective of the study is to investigate the direct effects of organizational innovation and R&D and the complementary effect of these two factors on

product innovation outcomes in five large ASEAN economies (i.e., Indonesia, Malaysia, the Philippines, Thailand, and Vietnam).

This study makes some contributions to the literature. First, while the contribution of R&D to firm innovation is widely recognized, little is known about the role of organizational innovation and the combination of this type of innovation with R&D for product innovation efforts. In fact, there are still limited studies on the complementary effect of organizational innovation and R&D on product innovation. To the best of our knowledge, there has been only one paper by Anzola-Román et al. (2018) that examines this problem. Thus, this research makes a theoretical contribution to the currently limited literature on this research theme by emphasizing that the joint adoption of both organizational innovation and R&D activities can strengthen two interrelated assets and capabilities, resulting in a complex innovation system and subsequently enhanced technological innovation.

Second, to the authors' knowledge, this is the first attempt to comprehensively investigate the role of organizational innovation and its interaction with R&D for innovative purposes in ASEAN–a region that is less studied in the innovation literature. Thus, the results are informative for practitioners at both the firm level and the macro level to design appropriate strategies and policies to enhance ASEAN firms' innovation performance.

Third, in terms of research method, we employ a generalized ordered logit model (GOLM) to address the common restrictive "parallel regression/proportional odds" assumption of the standard ordered logit model (OLM), which can make our estimation more efficient.

The rest of the study is structured as follows. Section 2 reviews the roles of organizational innovation and R&D and their joint effect on product innovation, followed by the hypothesis development. Section 3 describes the data and research method. We discuss the findings in section 4. Finally, section 5 concludes and proposes some important implications.

## Literature review and hypotheses

### *Related concepts*

*Product innovation*

The Oslo Manual provided a widely used definition of "product innovation". Product innovation is defined as "the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics." (OECD, 2005, p. 48).

*Organizational innovation*

In general, organizational innovation has been less mentioned in the literature than technological innovation (i.e., product and process innovation) (Camisón & Villar-López, 2014; Sapprasert & Clausen, 2012; Salamzadeh, 2015, 2018). The reasons for this inadequate attention in the literature include: (i) no single coherent theoretical framework on organizational innovation, (ii) ambiguity surrounding the term "organizational innovation", and (iii) lack of clear operationalization of "organizational innovation" as a variable (Lam, 2004; Sapprasert & Clausen, 2012).

To partially address these issues, the third edition of the Oslo Manual (OECD, 2005) introduced the standard and most widely used definition of "organizational innovation": "organizational innovation is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations" (OECD, 2005, p. 51).

*Organizational innovation and product innovation*

Organizational innovation can contribute positively to product innovation for several reasons. First, organizational innovation can improve intra-organizational coordination and create an appropriate environment to facilitate the creativity and flexibility to have better technological innovation (Azar & Ciabuschi, 2017; Damanpour et al., 1989; Haned et al., 2014). Second, as firms channel resources on new organizational forms and practices, they are more capable of managing new knowledge and technologies. This contributes positively to their technological innovation efforts because they can absorb advanced technological knowledge easier (Le Bas, Mothe, & Nguyen-Thi, 2015; Tavassoli & Karlsson, 2015). In this sense, organizational innovation plays as an input for firms' technological innovation (Anzola-Román et al., 2018; Haned et al., 2014). Third, organizational innovation often comes from high management, and then spreads to the rest of the organization. Product innovation, on the other hand, often comes from a specific department. When high-level managers concentrate on organizational innovation, it means that they are concerned about the firm's overall performance and in a valuable position to support product innovation activities (Anzola-Román et al., 2018; Daft, 1978).

The majority of empirical studies show evidence of the positive impact of organizational innovation on technological innovation, with the context focusing on developed countries (e.g., Anzola-Román et al., 2018; Cozzarin, 2017; Haned et al., 2014; Mothe, Nguyen-Thi, & Nguyen-Van, 2015). In particular, Haned et al. (2014), using firm-level data from three waves of "French Community Innovation Surveys", found that organizational innovation positively affects technical innovation. Similarly, Mothe et al. (2015), based on data from the 2008 "French Community Innovation Survey", also found that different categories of organizational innovation are positively associated with product innovation. Cozzarin (2017), employing the Canadian "Survey of Innovation and Business Strategy" (SIBS 2009) with the dataset of 2,500 manufacturing firms, found that organizational innovation positively affects product innovation. Recently, Anzola-Román et al. (2018), utilizing the Spanish PITEC database constituting the dataset of 9,586 Spanish firms, found the positive direct influence of innovation in organizational aspects on new product development. Thus, we propose the following hypothesis:

**Hypothesis 1:** Organizational innovation is positively related to the likelihood of product innovation.

*R&D and product innovation*

R&D has long been considered one of the main determinants of product innovation (Love & Roper, 1999). As mentioned in the seminal papers by Cohen and Levinthal (1990) and Griffith, Redding, and Reenen (2004), R&D has two faces: (i) stimulating innovation, (ii) and enhancing

firms' ability to assimilate and exploit existing knowledge (absorptive capacity).

R&D directly stimulates innovation by creating a new stock of scientific knowledge and new technologies, which in turn can be utilized in many ways to perform product innovation (Kafouros, 2008; Farsi et al., 2011). According to the resource-based view, internal R&D is an important internal resource that forms a "basic competence" for technological innovation (Tidd, 2000).

Another aspect of R&D is its contribution to building a firm's absorptive capacity. Cohen and Levinthal (1990, p. 128) defined absorptive capacity as "a firm's ability to recognize the value of new information, assimilate it, and apply it to commercial ends". R&D can enhance firms' absorptive capacity so that they are more capable of exploiting external knowledge. Thus, absorptive capacity is considered as a "byproduct" of R&D activities. Hence, investment in R&D is crucial to innovation via the absorptive channel; and the more firms spend on R&D activities, the more it can exploit fully external knowledge (Barbosa, Faria, & Eiriz, 2013; Cohen & Levinthal, 1990; Ganotakis & Love, 2010).

R&D is commonly classified into internal and external R&D (Barbosa et al., 2013; Rehman, 2016; Doshmanli et al., 2018). Internal R&D refers to the case that R&D activities are carried out within the firm, while external R&D indicates that R&D activities are performed in collaboration with outside partners such as other companies, universities, research institutes (Chesbrough, 2006). In his seminal work, Chesbrough (2006) pro-

posed the term "open innovation", defined as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively". Open innovation practices can enrich the external knowledge necessary for firms to conduct product innovation (Un & Asakawa, 2015).

There have been many empirical studies on the direct effect of R&D on product innovation. Most of these studies show a positive impact of R&D on product innovation with the context concentrating on developed countries. For example, Ganotakis and Love (2010), using data of 412 companies in the UK during 2001-2004, found that internal R&D leads to product innovation, while spending on external R&D does not affect innovation. Barbosa et al. (2013), based on the sixth wave of the "Community Innovation Survey"–CIS6 in Portugal with the final sample of 2,983 firms during 2004–2006, found that firms with R&D cooperation have more likelihood of conducting incremental or radical innovation. Moreover, extramural R&D investment raises innovation, whereas intramural R&D intensity does not affect innovation. Haned et al. (2014) pointed out that internal and external R&D enhance new product development, based on the sample of 1,180 manufacturing firms from the French CIS, CIS4, CIS6, CIS8 during 2002–2008. Recently, Mothe et al. (2015), employing the dataset of 568 observations from the CIS6 in Luxembourg in 2008, established that the intensity of R&D is positively linked with product innovation in the Biprobit model.

There are also some studies in the context of large developing countries. For instance, Huang, Rice, and Martin (2015), utilizing the sample of

2,400 Chinese firms from the "World Bank Investment Climate Survey" in 2003, showed evidence that absorptive capacity (proxied by the size of total R&D personnel) has a positive effect on big firms' innovation performance. Similarly, Rehman (2016), based on the sample of 3,492 firms in India and 696 firms in Pakistan (from the "World Bank Enterprise Survey" in 2013), confirmed that both internal and external R&D enhance new product development.

Based on the above theoretical background and empirical literature, we propose the following hypothesis:

**Hypothesis 2**: R&D is positively related to the likelihood of product innovation.

*The complementary effect of organizational innovation and R&D*

As suggested in the previous discussion, R&D plays an important role in stimulating product innovation, and organizational innovation also contributes positively to product innovation outcomes. Therefore, we can expect that the combination of both factors can give an enhancing effect on product innovation efforts. Furthermore, based on the resource-based view theory, the adoption of organizational innovation along with R&D can strengthen two interrelated assets and capabilities, which results in a complex innovation system and thus enhanced technological innovation outcomes (Anzola-Román et al., 2018; Hervas-Oliver & Sempere-Ripoll, 2015).

The empirical literature on the complementary effect of organizational innovation and R&D on innovation is rather limited. To the best of

our knowledge, there has been only one paper by Anzola-Román et al. (2018) that examines this problem empirically. However, Anzola-Román et al. (2018) could not find evidence of the complementary effect.

Based on the above argument, we propose the following hypothesis:

**Hypothesis 3:** Organizational innovation and R&D have a positive complementary effect on the likelihood of product innovation.

## Data and research method

### *Data*

We use firm-level data from the World Bank's Enterprise Survey (ES). The ES is one of the most comprehensive databases of firms operating in developing countries with more than 140,000 private firms in 140 countries (Luo & Bu, 2016; World Bank, 2019). We will focus on five large ASEAN economies in our analysis. In particular, we use data from ES 2015 for four countries (i.e., Indonesia, Malaysia, the Philippines, Vietnam) and ES 2016 for Thailand. In addition, our study only concentrates on manufacturing firms with two-digit industrial classification codes from 15 to 37, based on the "United Nations' International Standard Industrial Classification (ISIC Revision 3.1)" (United Nations Statistical Division, 2002).

### *Research method*

To test the hypotheses, this study employs the following theoretical model:

$$Innovation_i = \beta_0 + \beta_1 Organizational\ innovation_i + \beta_2 R\&D_i + \beta_3 Organizational\ innovation \text{ x } R\&D_i + \beta_4 Control_i + \varepsilon_i$$

Table 1 describes the detailed definition and measurements of all variables in the model.

**Table 1.** Variables description

| Variable | Description |
|---|---|
| **Dependent variable** | |
| **Innovation** | The level of firm innovation, = 0 (no innovation), = 1 (innovation but only new the firm), = 2 (innovation and new to the market) |
| **Independent variables** | |
| **Organizational innovation** | Dummy variable, = 1 if the firm answered "Yes" to the question "During the last three years, has this establishment introduced any new or significantly improved organizational structures or management practices?" |
| **R&D** | Dummy variable, = 1 if the firm answered "Yes" to the question "During the last three years, did this establishment spend on formal research and development activities, either in-house or contracted with other companies, excluding market research surveys?", = 0 otherwise |
| **Organizational innovation x R&D** | Interaction variable between Organizational innovation and R&D |
| **Control variables** | |
| **Firm age** | Log of total years in operation of the firm |
| **Firm size** | Log of the firm's total employees |
| **Country** | Country dummies for each of the five countries |
| **Industry** | Two-digit dummies for the main registered operation sector of the firm |

Considering the ordinal characteristics of the dependent variable (*Innovation*), the commonly used ordered logit model is preferred in estimation. It is more advantageous than conventional binary choice models such

as logit or probit models in terms of the ability to consider the degree of innovation. Nevertheless, one of the limitations when using the standard OLM is the too restrictive "parallel regression/proportional odds" assumption (Long & Freese, 2006). The "parallel regression/proportional odds" assumption requires "unchanged slope coefficients in all response categories" (Long & Freese, 2006). The violation of this assumption can result in "incorrect, incomplete, or misleading results" (Williams, 2006). The "Brant test" is widely used to test this assumption (Brant, 1990; Long & Freese, 2006). In empirical studies, it is very common that this assumption is violated because it is considered too restrictive (Williams, 2006). To address this issue, we adopt a generalized ordered logit model (GOLM) introduced by Williams (2006). The innovation of the GOLM is that it only performs a "partial proportional odds" procedure, which helps overcome the restrictive "parallel regression/proportional odds" assumption. Williams (2006) develops the command "gologit2" to estimate the GOLM in Stata.

## Findings and discussions

### *Descriptive statistics*

Table 2 shows the descriptive statistics of the variables in our analysis. About 18% of firms performed organizational innovation, while 15% of firms reported conducting formal R&D activities. Besides, about 8% of firms conducted both organizational innovation and R&D practices. Regarding the dependent variable–*Innovation*. There are approximately 21% of firms conducting innovation of both types. Specifically, the proportion of

firms conducting "new-only-to-the-firm" and "new-to-the-market" innovation is 7% and 14%, respectively.

**Table 2.** Descriptive statistics

| Variable | Observations | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|---|
| **Innovation** | 3,928 | 0.35 | 0.71 | 0 | 2 |
| **Organizational innovation** | 3,880 | 0.18 | 0.38 | 0 | 1 |
| **R&D** | 3,867 | 0.15 | 0.36 | 0 | 1 |
| **Organizational innovation x R&D** | 3,832 | 0.08 | 0.27 | 0 | 1 |
| **Firm age** | 3,928 | 2.79 | 0.62 | 0 | 4.38 |
| **Firm size** | 3,928 | 3.98 | 1.45 | 0.69 | 9.90 |

Table 3 reports the pairwise correlation coefficients. It can be seen that the correlation coefficients between the interaction variable *Organizational innovation* x *R&D* and two variables *Organizational innovation* and *R&D* are greater than 0.5, which indicates a signal of multicollinearity problem (Dormann et al., 2013). Thus, we will estimate the direct effects (Hypothesis 1 and 2) and complementary effect (Hypothesis 3) separately to avoid the possibility of the multicollinearity problem.

**Table 3.** Pairwise correlation

| | Organizational innovation | R&D | Organizational innovation x R&D | Firm age | Firm size |
|---|---|---|---|---|---|
| **Organizational innovation** | 1 | | | | |
| **R&D** | 0.4040*** | 1 | | | |
| **Organizational innovation x R&D** | 0.6490*** | 0.7037*** | 1 | | |
| **Firm age** | 0.0485*** | 0.0473*** | 0.0589*** | 1 | |
| **Firm size** | 0.2369*** | 0.2670*** | 0.2295*** | 0.2063*** | 1 |

Notes: * p < .10; ** p < .05; *** p < .01

## Results

Table 4 presents the estimation results using both the GOLM and OLM. Due to the risk of the multicollinearity problem, we estimate the direct effects (Hypothesis 1 and 2) in Model 1 and Model 3 and the complementary effect (Hypothesis 3) in Model 2 and Model 4. We begin by estimating Model 3 and Model 4 with the standard OLM. The Brant test results (not shown here for brevity) show evidence of the violation of the "parallel regression/proportional odds" assumption, which suggests GOLM is a good alternative. We then estimate Model 1 and Model 2 with the GOLM. Overall, the estimation results from both models are quite similar, which indicates the robustness of our findings.

Regarding the role of organizational innovation in product innovation, we find that the coefficients of *Organizational innovation* are statistically significant and positive in both Model 1 and Model 3, which indicates that firms conducting organizational innovation are more likely to perform product innovation at a higher degree of radicalness. Thus, Hypothesis 1 is strongly supported. The results are consistent with those found in developed countries (e.g., Anzola-Román et al., 2018; Cozzarin, 2017; Haned et al., 2014; Mothe et al., 2015). The possible reason is that firms conducting organizational innovation can enhance intra-organizational coordination and have more capability of managing complex knowledge and technologies, which contributes positively to product innovation. Furthermore, the results also support the argument proposed in previous studies on the top-down characteristics of organizational innovation, putting firms in a better posi-

tion for product innovation performance (e.g., Anzola-Román et al., 2018; Daft, 1978).

As for the role of R&D in product innovation, we find that the coefficients of *R&D* are significantly positive in both the GOLM and OLM, which provides support for Hypothesis 2. The results indicate that firms performing R&D activities are more likely to conduct product innovation at a higher degree of radicalness. Our findings lend support to the conventional argument in the innovation literature that R&D contributes positively to innovation by creating a new stock of scientific knowledge and new technologies, which can be directly used to come up with product innovation.

**Table 4.** GOLM and OLM estimation results

| | **GOLM** | | | | **OLM** | |
|---|---|---|---|---|---|---|
| | **Model 1** | | **Model 2** | | **Model 3** | **Model 4** |
| | **(I)** | **(II)** | **(I)** | **(II)** | | |
| **Organizational innovation** | 1.281*** | 1.281*** | | | 1.266*** | |
| | (0.105) | (0.105) | | | (0.104) | |
| **R&D** | 1.322*** | 1.127*** | | | 1.233*** | |
| | (0.114) | (0.120) | | | (0.108) | |
| **Organizational innovation x R&D** | | | 1.751*** | 1.751*** | | 1.732*** |
| | | | (0.127) | (0.127) | | (0.127) |
| **Firm age** | 0.335*** | 0.335*** | 0.322*** | 0.322*** | 0.328*** | 0.321*** |
| | (0.076) | (0.076) | (0.074) | (0.074) | (0.076) | (0.074) |
| **Firm size** | 0.073** | 0.073** | 0.156*** | 0.156*** | 0.078** | 0.158*** |
| | (0.033) | (0.033) | (0.031) | (0.031) | (0.032) | (0.031) |
| **Country (dummies)** | Included | Included | Included | Included | Included | Included |
| **Industry (dummies)** | Included | Included | Included | Included | Included | Included |
| **Constant** | - | - | - | - | | |
| | 2.745*** | 3.579*** | 2.652*** | 3.348*** | | |
| | (0.595) | (0.598) | (0.588) | (0.589) | | |
| **/cut1** | | | | | 2.825 | 2.699 |

| | GOLM | | OLM | |
|---|---|---|---|---|
| | | | (0.593) | (0.586) |
| **/cut2** | | | 3.451 | 3.287 |
| | | | (0.594) | (0.587) |
| **LR $\chi^2$** | 864.74 | 656.82 | 790.61 | 592.07 |
| **Prob > $\chi^2$** | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| **Observations** | 3,832 | 3,832 | 3,832 | 3,832 |

Notes: Standard errors in parentheses. * p < .10; ** p < .05; *** p < .01
(I): no innovation compared with "new-only-to-the-firm" or "new-to-the-market" innovation
(II): no or "new-only-to-the-firm" innovation compared with "new-to-the-market" innovation

We find evidence of the positive complementary effect of organizational innovation and R&D on the likelihood of innovation at a higher degree of radicalness. The coefficients of *Organizational innovation* x *R&D* are statistically significant and positive in both Model 2 and Model 4. Thus, Hypothesis 3 is strongly supported. Our findings are different from the insignificant complementary effect found in Anzola-Román et al. (2018). The possible explanation for the positive joint effect is that as firms conducted organizational innovation along with R&D, both activities can create a complex and supporting innovation system that results in an enhancing effect on innovation performance.

The two control variables–*Firm age* and *Firm size* are statistically significant and positive in both the GOLM and OLM. The results may imply that as firms have more time in operation, they can better accumulate knowledge and understandings of the market that are useful for innovative purposes. They can also have more opportunities to realize previously invested innovation efforts. Furthermore, larger firms tend to have more resources in terms of human and financial capital, so they can channel these resources for conducting innovation.

In fact, ASEAN–a region with 620 million people (nearly 9% of the world population) and GDP of more than $2.3 trillion (accounting for 3.3% of the world GDP) is one of the most dynamic and open economic regions in the world (ADB Institute, 2014). However, most ASEAN economies rely on low-wage and labor-intensive production, which cannot ensure sustainable development and competitiveness. As a result, shifting to a more knowledge-intensive and innovative economy by broadening and enhancing science, technology, and innovation capacities is a policy priority (ADB Institute, 2014; ERIA, 2018). With respect to innovation, we find that that investing in R&D, organizational innovation, and the joint adoption of both practices are conducive to product innovation in ASEAN. R&D shows a positive impact on innovation, partly due to the fact that ASEAN is a dynamic, fast-growing, and fast-changing consumer market. To gain competitive advantages and satisfy customers' preferences, ASEAN firms have to invest more in R&D to develop new or significantly improved products. This practice should be encouraged because the current investment in the R&D of ASEAN countries is rather low. Specifically, according to the "Global Competitiveness Report 2019" of the World Economic Forum, rankings (rank/141 economies) in terms of the indicator "R&D expenditures % GDP" of our ASEAN countries (except Malaysia (24)) are medium to low: Indonesia (116), Philippines (102), Thailand (48), and Vietnam (70) (Schwab, 2019). Organizational innovation is equally important as the introduction of new or significantly improved organizational structures or management practices can help strengthen internal cooperation, organiza-

tional flexibility, and adaptability for innovation efforts. This relatively new source of innovation is of particular importance for ASEAN countries as most of ASEAN firms still have a low level of technological and managerial development (ERIA, 2018). Making organizational innovation can therefore facilitate their progress toward technological innovation. In addition, the joint adoption of the two above-mentioned practices can create a firm's complete innovation system, which is vital for the economic development of ASEAN–a center of global economic gravity shifting toward Asia (ADB Institute, 2014).

### 4.3 Robustness test

To test the robustness of our results, we estimate an ordered probit model (OPM) with the same model specification (Table 5). Overall, the estimation results are similar to those reported in Table 4, which indicates the robustness of our findings. In particular, the coefficients of *Organizational innovation*, *R&D,* and *Organizational innovation* x *R&D* are statistically significant and positive, confirming Hypothesis 1, Hypothesis 2, and Hypothesis 3, respectively.

**Table 5.** OPM estimation – robustness test

| | OPM | |
|---|---|---|
| | **Model 5** | **Model 6** |
| **Organizational innovation** | 0.753*** | |
| | (0.061) | |
| **R&D** | 0.717*** | |
| | (0.064) | |
| **Organizational innovation x R&D** | | 1.033*** |
| | | (0.076) |
| **Firm age** | 0.170*** | 0.172*** |
| | (0.042) | (0.041) |
| **Firm size** | 0.044** | 0.089*** |
| | (0.018) | (0.017) |
| **Country (dummies)** | Included | Included |
| **Industry (dummies)** | Included | Included |
| **/cut1** | 1.635 | 1.591 |
| | (0.320) | (0.316) |
| **/cut2** | 1.980 | 1.915 |
| | (0.320) | (0.317) |
| **LR $\chi^2$** | 777.79 | 576.29 |
| **Prob > $\chi^2$** | 0.0000 | 0.0000 |
| **Observations** | 3,832 | 3,832 |

Notes: Standard errors are in parentheses. * p < .10; ** p < .05; *** p < .01

## Conclusions and implications

This study examines the roles of organizational innovation, R&D, and the combination of both factors in product innovation. We use a novel ordinal regression method (i.e., GOLM) to address the common restrictive "parallel regression/proportional odds" assumption of the standard OLM. The findings show that organizational innovation, R&D, and the combination of both factors have significantly positive effects on the possibility of innovation at a higher degree of radicalness in ASEAN. The results lend support to our argument that the joint adoption of both organizational innovation and R&D practices can create a complex and supporting innovation

system, leading to better innovation performance. With the ASEAN dataset, our study is probably the first that can find the positive impact of this combination, while Anzola-Román et al. (2018) could not find the complementary effect in Spain.

Given the results, we suggest some practical implications. First, making organizational changes is important for gaining competitiveness and innovation. Hence, managers should put more emphasis on continuous improvement of organizational structures or implementation of advanced management techniques to facilitate innovation efforts. Second, as organizational innovation and R&D have positive complementary effects on product innovation, managers should consider combining both to have more enhancing effects on their innovation efforts. The investments and efforts spent on conducting both organizational innovation and R&D may be considerable, but the returns are also rewarding.

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